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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classificati n 6 : H02G 1/14

A1

(11) International Publicati n Number: WO 98/34309

(43) International Publication Date: 6 August 1998 (06.08.98)

(21) International Application Number: PCT/SE98/00165

(22) International Filing Date: 2 February 1998 (02.02.98)

(30) Priority Data:

9700353-7	3 February 1997 (03.02.97)	SE
9704424-2	28 November 1997 (28.11.97)	SE

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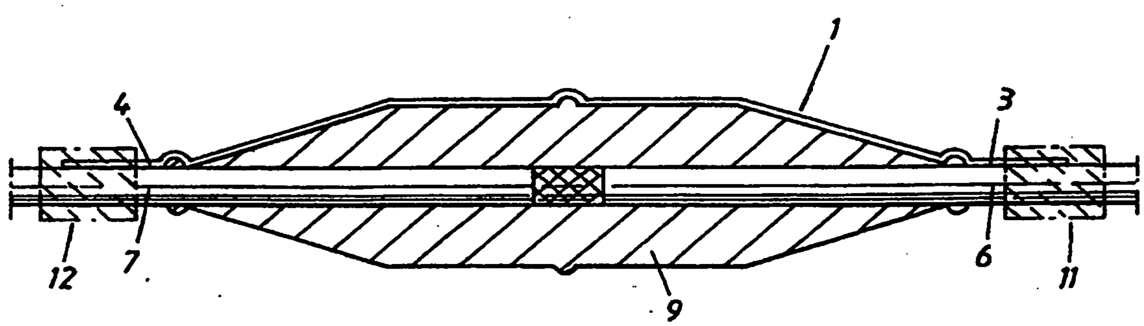
(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, CZ (Utility model), DE, DE (Utility model), DK, DK (Utility model), EE, ES, FI, FI (Utility model), GB, GE, GH, GM, GW, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

Published
With international search report.

(54) Title: AN ARRANGEMENT FOR CABLE JOINTS AND A ROTATING ELECTRIC MACHINE INCLUDING SAID ARRANGEMENT



(57) Abstract

The invention relates to an arrangement for use in cable joints, particularly joints on bent cables. The cable joint comprises two cables (6, 7; 18, 19; 45, 46) and a splicing joint (9; 16; 43) applied between the cables. The arrangement is characterized in that it includes a support (1; 15; 40, 41) designed for application over the joint so that the parts (6, 7, 9; 16, 18, 19; 43, 45, 46) forming the joint, remain substantially immovable in relation to each other, and that it includes at least one securing element (11, 12; 21, 22; 50, 51) by means of which the support is resiliently secured to the cable, and said securing element being capable of absorbing dimensional changes of the cable due to thermal expansion or contraction. The invention also relates to a rotating electric machine comprising a stator with windings drawn through slots in the stator, and a rotor, the machine being characterized in that it includes the arrangement described for cable joints.

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AN ARRANGEMENT FOR CABLE JOINTS AND A ROTATING ELECTRIC MACHINE INCLUDING SAID ARRANGEMENT

The present invention relates to an arrangement for use in cable joints, preferably premoulded cable joints on bent cables, as described in the preamble to claim 1.

The invention also relates to a rotating electric machine as described in the preamble to claim 24.

A cable joint usually includes two cables and a joint fitted between the cables in order to join them.

Cable joints are usually fitted on straight cables located in the ground or on cable ladders, the cable joint and the cable being solidly locked in relation to each other.

However, by using cables, i.e. high-voltage insulating electric conductors, in the stator winding of a rotating electric machine, the cable joint will be fitted on bent (curved) cables and will thus be subjected to a new type of stress, i.e. flexural stress. The cable joint and cables will also be subjected to movements due both to thermal expansion and mechanical vibrations. Another problem in connection with such a use is that it is not possible to anchor the cables and the cable joint in a common fastening device.

In EP 0 732 787 is disclosed a device for encapsulating cable joints. In Fig. 2 of this document is illustrated a stabilizing bar attached along the joint. The purpose of this bar is to provide structural stability to the joint and in particular to prevent sharp bending. The bar is secured to the jacket of the cable by means of compressive fastening members. This document also discloses a flexible (or hard) shell arranged to surround the cable joint and which is being filled with a curable encapsulant, in order to seal

the cable joint. The encapsulant cures into a gel-like consistency. Other devices for encapsulating cable joints, in particular various sleeve designs, are known from DE 34 41 311 and EP 0 316 911, for instance.

However, none of the known devices are capable of keeping the parts forming the joint, i.e. the two cables and the cable joint, immovable in relation to each other, while, at the same time, changes in dimension of the cable, primarily due to thermal expansion and contraction, may be absorbed without damage to the device.

Examples of rotating electric machines, which are relevant in the present context, are synchronous machines, normal asynchronous machines as well as double-fed machines, alternating current machines, applications in asynchronous static current converter cascades, outerpole machines and synchronous flux machines.

The arrangement according to the invention is particularly suitable for a rotating electric machine operating as a generator in a power station for generating electric power.

The object of the present invention is to provide an arrangement for cable joints designed to solve the problems described above, in particular at joints on bent cables.

This object is achieved by an arrangement of the type described in the preamble to claim 1 being given the special features defined in the characterizing part of the claim.

Another object is to provide a rotating electric machine in which the problem under discussion has been solved. This object is achieved through a machine of the type described in the preamble to claim 24 being given the features defined in the characterizing part of that claim.

Thus, by providing an arrangement in the form of a support designed for application over the cable joint so that the parts included in the joint remain substantially immovable in relation to each other, said support comprising at least one securing element by means of which the support is resiliently secured to the cable, and said securing element being capable of absorbing dimensional changes of the cable due to thermal expansion or contraction, the advantage is achieved that the joint is and remains straight, and that the joint area is not subjected to flexural stresses. At the same time changes in the cable dimension are absorbed and will therefore not have any adverse effects on the joint. Consequently, the arrangement results in a very reliable and safe cable joint.

The arrangement also has the advantage that it can be used not only in high-voltage electric machines, but also in other contexts where support is required for a cable joint, particularly for bent cables.

The cables, for which the arrangement according to the invention is intended, are preferably used in windings and are preferably of a type having solid, extruded insulation, of a type now used for power distribution, such as XLPE-cables or cables with EPR-insulation. Such a cable comprises an inner conductor composed of one or more strand parts, an inner semiconducting layer surrounding the conductor, a solid insulating layer surrounding this and an outer semiconducting layer surrounding the insulating layer. Such cables are flexible, which is an important property in this context since the technology for the arrangement according to the invention is based primarily on winding systems in which the winding is formed from cable which is bent during assembly. The flexibility of an XLPE-cable normally corresponds to a radius of curvature of approximately 20 cm for a cable with a diameter of 30 mm, and a radius of curvature of approximately 65 cm for a cable with a diameter of 80 mm. In

the present application the term "flexible" is used to indicate that the winding is flexible down to a radius of curvature in the order of four times the cable diameter, preferably eight to twelve times the cable diameter.

The winding should be constructed to retain its properties even when it is bent and when it is subjected to thermal stress during operation. It is vital that the layers retain their adhesion to each other in this context. The material properties of the layers are decisive here, particularly their elasticity and relative coefficients of thermal expansion. In an XLPE-cable, for instance, the insulating layer consists of cross-linked, low-density polyethylene, and the semiconducting layers consist of polyethylene with soot and metal particles mixed in. Changes in volume as a result of temperature fluctuations are completely absorbed as changes in radius in the cable and, thanks to the comparatively slight difference between the coefficients of thermal expansion in the layers in relation to the elasticity of these materials, the radial expansion can take place without the adhesion between the layers being lost.

The material combinations stated above should be considered only as examples. Other combinations fulfilling the conditions specified and also the condition of being semiconducting, i.e. having resistivity within the range of 10^{-1}-10^{6} ohm-cm, e.g. 1-500 ohm-cm, or 10-200 ohm-cm, naturally also fall within the scope of the invention.

The insulating layer may consist, for example, of a solid thermoplastic material such as low-density polyethylene (LDPE), high-density polyethylene (HDPE), polypropylene (PP), polybutylene (PB), polymethyl pentene ("TPX"), cross-linked materials such as cross-linked polyethylene (XLPE), or rubber such as ethylene propylene rubber (EPR) or silicon rubber.

The inner and outer semiconducting layers may be of the same basic material but with particles of conducting material such as soot or metal powder mixed in.

The mechanical properties of these materials, particularly their coefficients of thermal expansion, are affected relatively little by whether soot or metal powder is mixed in or not - at least in the proportions required to achieve the conductivity necessary according to the invention. The insulating layer and the semiconducting layers thus have substantially the same coefficients of thermal expansion.

Ethylene-vinyl-acetate copolymers/nitrile rubber (EVA/NBR), butyl graft polyethylene, ethylene-butyl-acrylate copolymers (EBA) and ethylene-ethyl-acrylate copolymers (EEA) may also constitute suitable polymers for the semiconducting layers.

Even when different types of material are used as base in the various layers, it is desirable for their coefficients of thermal expansion to be substantially the same. This is the case with the combination of the materials listed above.

The materials listed above have relatively good elasticity, with an E-modulus of E<500 MPa, preferably <200 MPa. The elasticity is sufficient for any minor differences between the coefficients of thermal expansion for the materials in the layers to be absorbed in the radial direction of the elasticity so that no cracks appear, or any other damage, and so that the layers are not released from each other. The material in the layers is elastic, and the adhesion between the layers is at least of the same magnitude as in the weakest of the materials.

The conductivity of the two semiconducting layers is sufficient to substantially equalize the potential along each layer. The conductivity of the outer semiconducting layer is sufficiently high to enclose the electrical field within the

cable, but sufficiently low not to give rise to significant losses due to currents induced in the longitudinal direction of the layer.

Thus, each of the two semiconducting layers essentially constitutes one equipotential surface, and these layers will substantially enclose the electrical field between them.

There is, of course, nothing to prevent one or more additional semiconducting layers being arranged in the insulating layer.

Since the arrangement according to the invention primarily is intended for use in cable joints where the jointed cables consist of high-voltage cable, its advantages being particularly prominent here, a special feature is stated to be that the cables are composed of high-voltage cable.

An additional characteristic is that the high-voltage cable has a diameter within the interval 20-250 mm and a conducting area within the interval 80-3000 mm^2.

Further characteristics and advantages of the present invention will become apparent from the remaining dependent claims.

As a particular advantage, the securing element is made of a resilient material.

According to a first embodiment of the invention the support comprises at least one rigid yoke, wherein the shape of the inner surface of the yoke, facing the joint, is adapted to the outer shape of the joint. The support being in the form of a yoke has the advantage of a very light construction which is easy to manufacture by means of compression moulding or casting. A yoke is also very easy to install over the joint. Several yokes may possibly be used, for example may a

support consist of three yokes, each with substantially the same shape.

As a further advantage, each yoke may have an elongate shape and terminate in two ends, and said securing element may comprise a resilient clamping device to position and secure said yoke to the two jointed cables.

According to a second embodiment the support is characterized in that it comprises a sleeve. The shape of the sleeve is adapted to the joint in that the inner diameter of the sleeve is substantially the same size as the largest outer diameter of the cable joint.

According to an advantageous modification of said second embodiment the sleeve is composed of two axial sleeve parts, which facilitates fitting the support over the joint. Dividing the sleeve into parts with gaps between them is also advantageous for cooling the joint.

The sleeve, or sleeve parts, according to this second embodiment may also advantageously be provided with small openings or slits in the wall of the sleeve to permit cooling of the joint inside the sleeve. The support further comprises at least one attachment means to hold together said sleeve parts.

This second embodiment and its modification also preferably includes two bushes, one for installation at each end of the sleeve to secure the sleeve to the cable.

Shaping the support as a sleeve, or two sleeve halves, with bushes offers the advantage of a particularly strong support, as well as protecting substantially the entire cable joint as well as a part of each cable from external influences.

The bush is preferably divided into two axial bush halves in order to facilitate assembly.

The bushes have the advantage that they may consist of prefabricated standard bushes for high-voltage and medium-voltage cables. A material often used is rubber, e.g. ethylene propene rubber or silicon rubber, which permits a certain resilience in retaining the cable. This is also advantageous from the thermal expansion aspect. The bush permits a certain amount of expansion in the cable and also adjusts itself when the cable cools down and shrinks.

According to a particularly advantageous embodiment the bushes are provided with special means for absorbing dimensional changes of the cable due to thermal expansion or contraction, preferably radial corrugations, either internally or externally. This offers the advantage that the bushes are able to absorb the thermal expansion in the cable insulation below.

According to another feature a particular advantage is obtained since the support and its accessories can be made of an electrically conducting material, thereby permitting earthing of the joint. Alternatively the support and its accessories can be made of an electrically insulating material if earthing is to be avoided.

Rotating electric machines have conventionally been designed for voltages in the range 6-30 kV, and 30 kV has normally been considered to be an upper limit. This generally means that a generator must be connected to the power network via a transformer which steps up the voltage to the level of the power network, i.e. in the range of approximately 130-400 kV.

The present invention is primarily intended for use with high voltages. High voltages shall be understood here to

mean electric voltages in excess of 10 kV. A typical operating range for an arrangement according to the invention may be voltages from 36 kV up to 800 kV. Secondarily, the invention is intended for use in the stated technical area at voltages below 36 kV.

By using high-voltage insulated electric conductors, also termed high-voltage cables, with solid insulation similar to that used in cables for transmitting electric power (e.g. XLPE cables) the voltage of the machine can be increased to such levels that it can be connected directly to the power network without an intermediate transformer. The conventional transformer can thus be eliminated. However, an important condition for this is that the cables can be jointed in a reliable manner, which is thus enabled by the present invention.

For a better understanding of the invention two embodiments of the invention will now be described in detail by way of example, with reference to the accompanying drawings in which:

Figure 1 shows schematically a support according to a first embodiment of the invention,

Figure 2 shows schematically a cross section of a cable joint with a support according to Figure 1 applied,

Figure 3 shows schematically a cross section of a cable joint with a support according to a second embodiment applied,

Figure 4 shows an alternative embodiment of a detail in the support according to Figure 3,

Figure 5 shows an embodiment according to a second alternative of a detail in the support according to Figure 3,

Figure 6 shows schematically a modification of the support in Figure 3, and

Figure 7 shows a cross section through a high-voltage cable for which the arrangement is particularly suitable.

According to the embodiment shown in Figure 1 the support is in the form of a yoke 1. The yoke has an elongate shape and terminates in two ends 3, 4. The shape of the yoke is adapted to the contour of the cable joint it is intended to support. In the example illustrated the shape of the yoke follows exactly the shape of the cable joint. However, it would also be possible for the inside only of the yoke to have a shape corresponding to the cable joint and its external side to have some other suitable shape, such as a shape that is simple from the manufacturing point of view.

The yoke is preferably applied centrally over the joint and its end parts 3, 4 are in contact with the two cables 6, 7 jointed by the cable joint 9, as illustrated in Figure 2. To secure the yoke to the cables the support also comprises a resilient clamping arrangement 11, 12 at each end. This clamping arrangement may consist of a tape wound around the end of the yoke and the cable, or it may consist of a cable binder or the like.

If the support is to be earthed the yoke is made of an electrically conducting material, e.g. metal. In this case the clamping arrangement must of course also be made of an electrically conducting material.

If, instead, it is requested that the support shall not permit earthing, then the material selected for the yoke and the clamping arrangements should be an electrically non-conducting material, e.g. plastic.

A second embodiment of the invention is illustrated in Figure 3. The support is here composed of a sleeve 15 fitted around a cable joint 16, preferably centrally over the joint. Two cables 18, 19 are jointed by means of this cable

joint. The shape of the sleeve follows that of the cable joint, in that the inside diameter of the sleeve is adapted to the external diameter of the cable joint. A bush 21, 22 is located at each end of the sleeve, the main purpose of which is to position and secure the sleeve around each cable.

The bushes may, for instance, consist of prefabricated standard bushes for high-voltage and medium-voltage cables. A material often used is rubber, e.g. ethylene propene rubber or silicon rubber, which permits a certain resilience in retaining the cable. This is advantageous from the thermal expansion aspect. The bush permits a certain amount of expansion in the cable and also adjusts itself when the cable cools down and shrinks.

Figures 4 and 5 illustrate two particularly advantageous embodiment modifications of the bush. In both cases the bush is divided into two axial bush halves.

Only one half of the bush is illustrated in Figure 4. This bush half 24 is provided with a semi-circular boring 25 for passage of the cable. The inner surface, i.e. facing the cable, is provided with a corrugation in the form of grooves 26 deep enough to allow the bush to absorb thermal expansion in the cable insulation below when the bush is fitted on the cable.

The bush half 28 illustrated in Figure 5 is instead provided with a corrugation on its outer surface, comprising grooves 30. These grooves are formed in the same way as the grooves in Figure 4 and have the same function. The bush is also provided with a central boring 29 facing the cable. The corrugated outer surface of the bush faces the inside of the sleeve.

It is of course possible to provide the bush with corrugations on both the inner and outer surfaces, which may be expedient when an extra high thermal expansion may be expected in the cable insulation below.

Figure 6 shows a modification of the second embodiment, shown in Figure 3. The sleeve here consists of two axial sleeve halves 40, 41 which surround a cable joint 43 for joining two cables 45, 46. The two sleeve halves have the advantage of being simpler to fit over the cable joint than the embodiment with an unbroken sleeve, which must be slipped around the joint. The sleeve halves 40, 41 are held together around the joint by means of an attachment means 48, which may be some form of resilient clamping arrangement, e.g. a cable binder. In the example illustrated an attachment means is provided at each sleeve end and one at the centre of the sleeve. The number of attachment means is chosen as required. At each end of the sleeve formed by the two sleeve halves is a bush 50, 51, corresponding to the bushes in Figure 3.

As is illustrated particularly well in Figure 6, the support maintains both the cable and the cable joint straight and immovable.

In the second embodiment, also, with a sleeve or sleeve halves, all parts may be made either of electrically conducting material to enable earthing, or of electrically insulating material. The sleeve may also be provided with small openings or slits 53 in the wall of the sleeve to facilitate cooling of the joint.

Finally, Figure 7 shows a cross section through a high-voltage cable 35, which is particularly suitable for use with the present invention. The high-voltage cable 35 includes a number of strand parts 31 made of copper (Cu), for instance, and having a circular cross section. These strand

parts are arranged in the centre of the high-voltage cable. Surrounding the strand parts 31 is a first semiconducting layer 32. Surrounding the first semiconducting layer 32 is an insulating layer 33, e.g. XLPE-insulation, and surrounding the insulating layer 33 is a second semiconducting layer 34. The cable illustrated differs from conventional high-voltage cable in that the outer, mechanically protective sheath and the metal screen that normally surround such a cable for power distribution have been eliminated. The concept "high-voltage cable" in the present application thus need not include the metal screen and the outer protective sheath that normally surround such a cable for power distribution.

The embodiments illustrated and described should be considered only as examples and the invention is not limited thereto but can be varied within the scope of the inventive concept as defined in the appended claims. It should be emphasized that the invention is not limited to bent cables but may be used for all types of cable joints requiring support.

CLAIMS

1. An arrangement for cable joints, preferably cable joints on bent cables, said cable joint comprising two cables and a splicing joint fitted between the cables to join them together, and said arrangement further comprising a support (1; 15; 40, 41), designed to be fitted over the joint so that the parts (6, 7, 9; 16, 18, 19; 43, 45, 46) forming the joint remain substantially immovable in relation to each other, characterized in that it comprises at least one securing element (11, 12; 21, 22; 50, 51) by means of which the support is resiliently secured to the cable, and said securing element being capable of absorbing dimensional changes of the cable due to thermal expansion or contraction.

2. An arrangement as claimed in claim 1, characterized in that the cables is a winding in a rotating electric machine, said winding being flexible and composed of an electrically conducting core surrounded by an inner semiconducting layer (32), an insulating layer (33) surrounding the inner semiconducting layer and consisting of solid material, and an outer semiconducting layer (34) surrounding the insulating layer, said layers adhering to each other.

3. An arrangement as claimed in claim 2, characterized in that said layers (32, 33, 34) consist of material having such elasticity and with such a relation between the coefficients of thermal expansion of the materials that the changes in volume in the layers caused by temperature fluctuations during operation can be absorbed by the elasticity of the material, the layers thus retaining their adhesion to each other upon the temperature fluctuations that occur during operation.

4. An arrangement as claimed in claim 3, characterized in that the materials in said layers (32, 33, 34) have high elasticity, preferably with an E-modulus less than 500 MPa, most preferably less than 200 MPa.

5. An arrangement as claimed in claim 3, characterized in that the coefficients of thermal expansion for the materials in said layers (32, 33, 34) are of substantially the same magnitude.

6. An arrangement as claimed in claim 3, characterized in that the adhesion between the layers (32, 33, 34) is of at least the same magnitude as in the weakest of the materials.

7. An arrangement as claimed in claim 2 or claim 3, characterized in that each of the semiconducting layers (32, 34) essentially constitutes one equipotential surface.

8. An arrangement as claimed in any of claims 2-7, characterized in that the cables (6, 7; 18, 19; 45, 46) consist of high-voltage cable (35).

9. An arrangement as claimed in claim 8, characterized in that the high-voltage cable (35) has a diameter within the interval 20-250 mm and a conducting area within the interval 80-3000 mm^2.

10. An arrangement as claimed in any of the preceding claims, characterized in that the securing element (11, 12; 21, 22; 50, 51) is made of a resilient material.

11. An arrangement as claimed in any of the preceding claims, characterized in that the support further comprises at least one rigid yoke (1), and that the shape of

the inner surface of said yoke, facing the joint, is adapted to the outer shape of the joint.

12. An arrangement as claimed in claim 11, characterized in that the support consists of three yokes, each with substantially the same shape.

13. An arrangement as claimed in claim 11 or claim 12, characterized in that each yoke (1) has an elongate shape and terminates in two ends (3, 4), and that said securing element comprises a resilient clamping device (11, 12) to position and secure said yoke to the two jointed cables (6, 7).

14. An arrangement as claimed in any of claims 1-10, characterized in that the support comprises a sleeve (15).

15. An arrangement as claimed in claim 14, characterized in that the sleeve is composed of two axial sleeve parts (40, 41) and that the support also comprises at least one attachment means (48) to hold together said sleeve parts.

16. An arrangement as claimed in claim 14 or claim 15, characterized in that the sleeve (15; 40, 41) is provided with small openings or slits (53) in the wall of the sleeve to permit cooling of the joint inside the sleeve.

17. An arrangement as claimed in any of claims 14, 15 or 16, characterized in that the securing element includes two bushes (21, 22; 50, 51), one for installation at each end of the sleeve to secure the sleeve to the cable.

18. An arrangement as claimed in claim 14, characterized in that each bush is divided into two axial bush portions.

19. An arrangement as claimed in claim 17 or claim 18, characterized in that the bushes are provided with means for absorbing dimensional changes of the cable due to thermal expansion or contraction.

20. An arrangement as claimed in claim 17 or claim 18, characterized in that said means comprises radial corrugations (26) provided on the inner surface of the bush (24), facing the cable.

21. An arrangement as claimed in any of claims 17, 18 or 19, characterized in that said means comprises radial corrugations (30) provided on the outer surface of the bush (24), facing the inside of the sleeve.

22. An arrangement as claimed in any of the preceding claims, characterized in that the support (1; 11, 12, 15; 40, 41) is made of an electrically conducting material in order to provide earthing.

23. A device as claimed in any of the preceding claims, characterized in that the support (1; 11, 12, 15; 40, 41) is made of an electrically non-conducting material in order to provide insulation.

24. A rotating electric machine comprising a stator with windings drawn through slots in the stator, and a rotor, characterized in that it includes an arrangement for cable joints as claimed in any of the preceding claims.

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Fig. 1

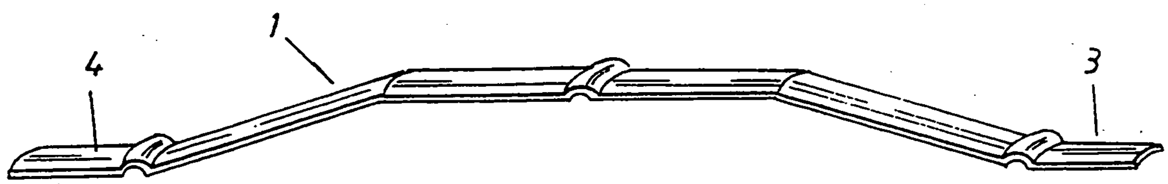

Fig. 2

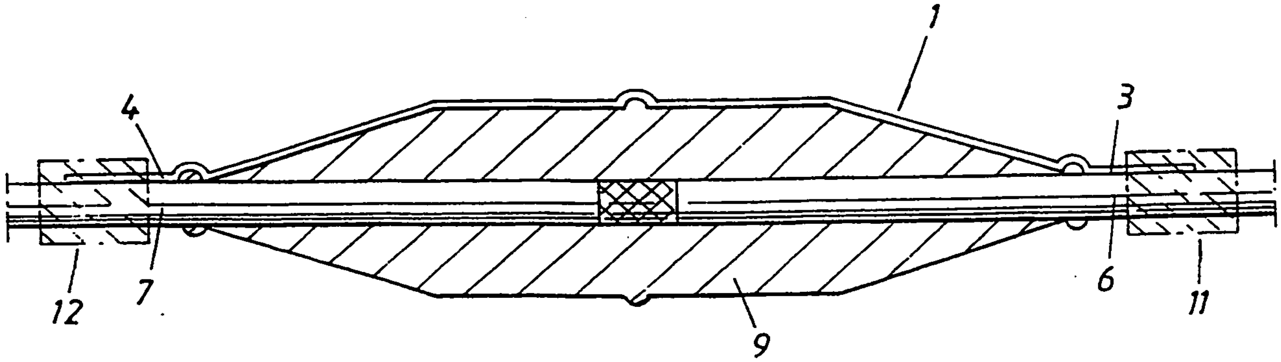

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Fig.3

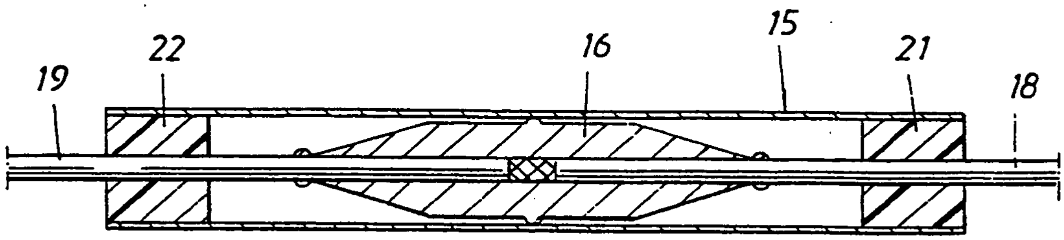

Fig.4

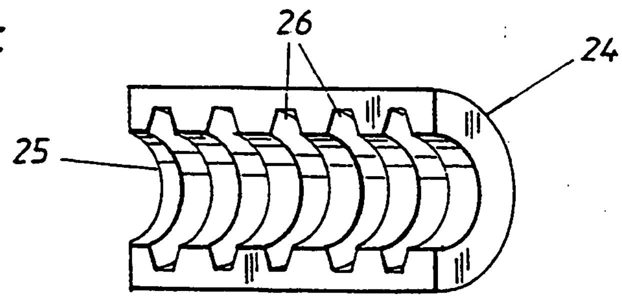

Fig.5

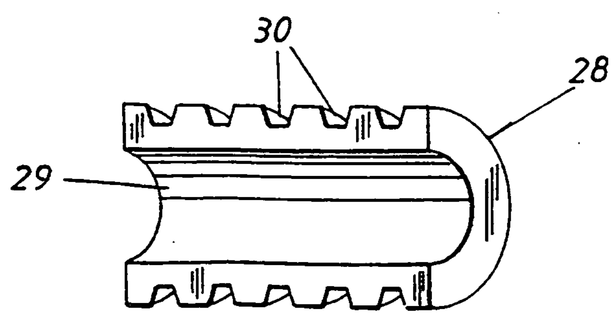

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Fig. 6

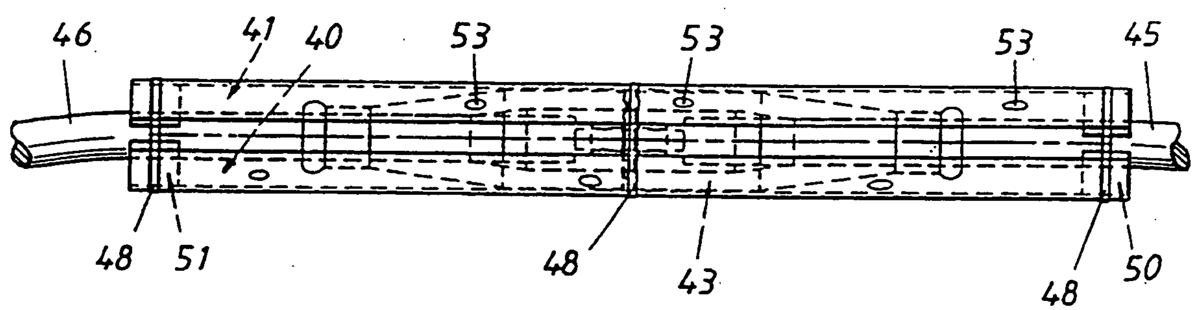
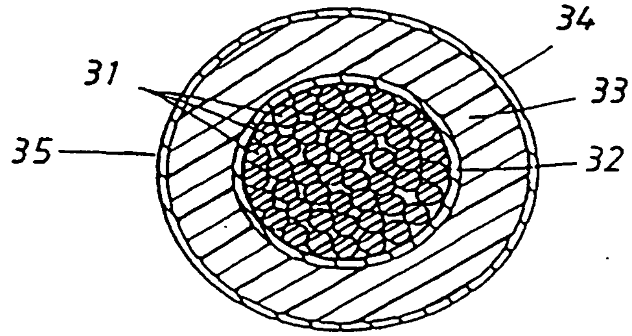


Fig. 7



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International application No.
PCT/SE 98/00165

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H02G 1/14
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H02G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI, EPODOC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0732787 A1 (THOMAS & BETTS CORPORATION), 18 Sept 1996 (18.09.96) --	1-24
A	DE 3441311 A1 (SIEMENS AG), 15 May 1986 (15.05.86) --	1-24
A	EP 0316911 A2 (NIPPON TELEGRAPH AND TELEPHONE CORPORATION), 24 May 1989 (24.05.89) --	1-24
A	GB 723457 A (STANDARD TELEPHONE AND CABLES LIMITED), 9 February 1955 (09.02.55) -- --------	1-24

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" erlier document but published on or after the international filing date

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 April 1998	19 -05- 1998

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INTERNATIONAL SEARCH REPORT
Information on patent family members

02/04/98

International application No.
PCT/SE 98/00165

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0732787 A1	18/09/96	CA 2167479 A	18/07/96
		JP 9023557 A	21/01/97
DE 3441311 A1	15/05/86	US 4656316 A	07/04/87
EP 0316911 A2	24/05/89	CA 1318948 A	08/06/93
		DE 3850047 D,T	15/09/94
		JP 1267030 A	24/10/89
		US 4933512 A	12/06/90
		JP 1936872 C	09/06/95
		JP 2097216 A	09/04/90
		JP 6067098 B	24/08/94
		JP 1135902 A	29/05/89
		JP 2093202 C	18/09/96
		JP 8003323 B	17/01/96
GB 723457 A	09/02/55	NONE	